

PRE-MASTERING AND CD-WO EVALUATIONS

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This article reviews the features and functionality of five desktop pre-mastering software packages for the PC. *Desktop* pre-mastering packages are aimed primarily at end-users interested in bringing CD-ROM publishing tasks in-house, rather than traditional CD-ROM developers. The focus is on the basics of installing, learning and using the software packages. It also addresses the functionality of these products in conjunction with new CD write-once (CD-WO) recorders and special pre-mastering capabilities, such as the production of multi-platform CDs for use on PC, Macintosh, UNIX or VAX computers. We had hoped to examine support for CD-ROM XA, CD-I, Photo CD, and other multimedia formats, but that review has been postponed until next summer.

Background

Four events have nurtured CD-ROM development. The support from Microsoft along with sponsorship of the international CD-ROM Conferences gave the industry visibility in its infancy. The ISO 9660 standard, born of the High Sierra proposal made CD-ROM the most transportable media in existence. The \$1,500 disk mastering price introduced by Discovery Systems brought competition to the mastering industry. The introduction of the Meridian Data, Inc. do-it-yourself pre-mastering system brought the gift of in-house CD development to the masses.

Meridian demonstrated their 'washing machine' at the Second Microsoft CD-ROM conference and promised to pre-master a Conference disk right therein the exhibit area. This was a breakthrough in an industry where vendors charged on the order of \$5,000 for pre-mastering services and turn-around time was measured in months. The Meridian system consisted of a 9-track tape drive, 1.2 gigabyte hard disk and the software. Wink Seville showed us his marvelous pre-mastering software in an abandoned train station in Pasadena in 1987. It is amazing to think that our CD-ROM lab is still using pretty much the same programs on a daily basis.

CD Production Steps

One would think that the process of taking user data files and making a CD-ROM image or CD-WO disk could be captured in a simple description or set of program functions. Alas, it is not so. There is very little in common between the programs we reviewed for this article. Terminology, user-interface and functionality vary widely from package to package. We will, however, attempt to summarize the general components and options of the process, which are shown in Figure 1.

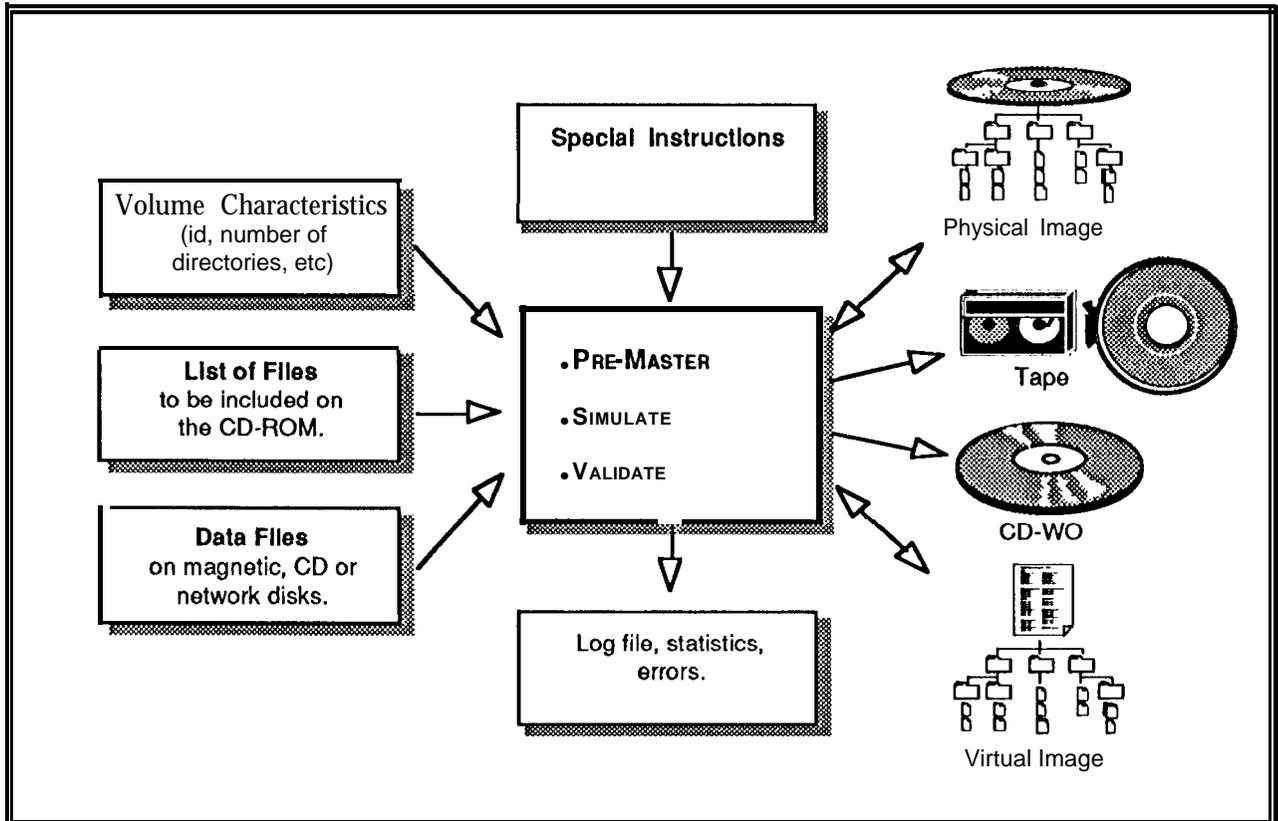


Figure 1: CD-ROM pre-mastering components.

The volume characteristics include the type of volume to be created (ISO 9660, HFS, etc.), its identifying characteristics (id, publisher, etc.) and the size of the root directory and path table, which determine the number of directories and files that can be put on the disk. These are often static, except for the 'volume id' and 'effective date and time'. A good system will allow the user to set default values for nearly all these fields, which can then be used over and over. It should, however, update dates and times with the current date/time of the system clock and notify the user if any of the defaults are violated when a disk is produced.

The second component is the script or list of input files and their target location on the CD-ROM. This may range from a wildcard specification like "D:*.*G:\ -d" which might copy an entire volume, to individual lines for each file, specifying some special action (create a hidden file or add an Extended Attribute Record field, or XAR, for example).

The third component is the collection of physical data files to be included on the CD-ROM. These may be located on any local hard disk, CD-ROM, or remote disk. In theory any device that can be viewed by your computer system as a random access file storage device should be accessible. It is important to consider

your standard operating procedures when evaluating potential pre-mastering systems, If you will be collecting files from a variety of devices, you may not be able to record directly to a CD-WO recorder. Figure 2 shows some approximate throughput rates of various devices. Please note that in order to support direct 2X recording on a CD recorder, your hard drive is recommended to have a transfer rate of at least 1.2 MB/sec. This number is derived from experience and is four times the theoretical minimum for 2X recording. The actual minimum transfer rate depends on the software and CD recorder used.

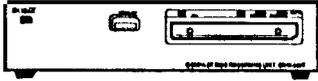
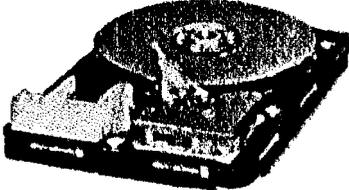
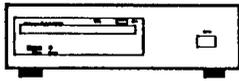
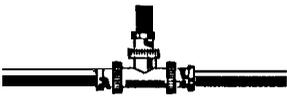
DEVICE	TRANSFER RATE	COMMENTS
 CD Recorder	 150/300 KB/sec	<div style="border: 1px solid black; padding: 5px;"> 1X speed = 150 KB/sec 2X speed = 300 KB/sec </div>
 Local Hard Disk	 1200 KB/sec	<div style="border: 1px solid black; padding: 5px;"> Fast un-fragmented SCSI hard drive should support 2X direct recording. </div>
 CD-ROM Reader	 150/300 KB/sec	<div style="border: 1px solid black; padding: 5px;"> 1X speed (150 KB/sec) reader will not support direct recording. </div>
 Ethernet (Novell/NFS)	 100 KB/sec	<div style="border: 1px solid black; padding: 5px;"> Network devices on ethernet will not support direct recording. </div>

Figure 2: Transfer rates of various devices used in pre-mastering.

CD recorders require very fast hard disk drives as a source because they are much different from floppy disk, hard disk, or magnetic tape drives. All other devices write data whenever data are transferred to the device. CD recorders, on the other hand, need data continuously because of the layout of a CD-ROM. On a CD-ROM, data are stored in 2,352-byte sectors, which include synchronization, header, error detection, and error correction data, as well as user data. The Layer-0 of error correction consists of the Cross Interleave Reed-Solomon Code (CIRC). In order to calculate the CIRC code, the CD recorder needs to know the data from the current block as well as the next block that will be written. This complicated interleaving scheme requires that data be transferred to the CD recorder continuously.

A fourth component in the production of a CD is a set of special instructions that contain processing commands such as converting non-standard file names to ISO 9660 compliant ones, creating hidden files or directories, or eliminating version numbers from file names.

A fifth component is a display of program status and messages. It should be possible to capture these messages in a log file for later perusal. Some programs allow these log files to be used as a script.

Statistics regarding the size of the volume, the number of directories and size and number of files in each directory should be available.

The standard output is a physical image, which can be written to disk, tape or CD-WO recorder. The term 'physical image' refers to a large file that contains (byte for byte) the data contents of a CD-ROM or CD-WO. Some programs only produce an image file on disk or tape, and require another program to copy the image to CD-WO. This doubles the time required for local CD production. A very useful feature found in **some** of the reviewed packages is *virtual publishing*, which creates a 'virtual image' containing pointers to the data files instead of creating a byte-for-byte copy of the data. This greatly reduces the amount of time required to begin testing a disk layout. The 'virtual image' can be used to simulate a CD, but modifications to the organization of the disk can be made without having to actually re-copy the data files.

Simulation allows applications to be tested before producing a CD-WO or mastered disk. This is an important feature if you do not have access to a CD-WO recorder. In our experience the best 'simulation' is the production of CD-WO copies for testing by real users on their own computers. These allow memory requirements, device dependencies and disk layout to be directly tested. However, some pre-mastering software packages offer added simulation features not available in "one-off" CD-WO user testing. Performance of several CD-ROM drives can be simulated in software and statistics on file usage can be kept. Some programs offer optimization of the CD directory structure based on the usage statistics collected during simulation.

Validation is a step that allows the user to verify that no errors have been made in creating an image file. Validation is accomplished by comparing the source files byte for byte with the CD-ROM image.

Summary of Reviewed Software

The following section provides summaries of each program's capabilities, and results of tests performed by the Data Distribution Laboratory. Table 3 shows the results of timing tests for each of the reviewed programs. Detailed feature comparisons are itemized in Table 4.

Table 1. CD-ROM support by platform (products in bold-italics are reviewed in this article.)

Vendor	PC	Macintosh	Other
CD-ROM Strategies	CD-Gen		
Dataware ¹	CDPrepare, CDMake		
Elektroson BV	GEAR	GEAR	GEAR 386i, HP
JVC Info. Products	Personal RomMaker	Personal RomMaker	
JVC Info. Products	Personal Archiver	Personal Archiver ²	
Meridian Data	CD-Publisher, Personal SCRIB	Mac CD-Publisher	
Meridian Data	Personal Publisher ³		
Optical Media Intl.	QuickTOPIX for Windows	QuickTOPIX for Macintosh	
Optical Media Intl.	PC TOPIX	MacTOPIX	
TMS			DiscArchitect (VMS) ⁴
Young Minds			Makedisc, CD Studio (UNIX)

¹- Vendor declined to participate in evaluation.
²- Available January 1993.

³- By the time of publication, *Personal Publisher* will be replaced by *Personal SCRIBE*
⁴- Product that is no longer supported.

The TMS, Meridian CD-Publisher, and Young Minds software are already owned by the Data Distribution Laboratory. Although, Dataware Technologies declined to participate in the review, they sell a pre-mastering package that supports both the Philips CDD 521 and Sony CDW-900E CD recorders.

Table 2. Subjective evaluations.

Product	Set-up	Learning Curve	Ease of Use	Capabilities	Overall Performance
CD-ROM Strategies CD-GEN	● 0000	● 0000	00000	● 0000	● 0000
Elektrosen GEAR	● 0000 ¹	● 0000	● 0000	● 0000	● 0000
JVC Personal Rommaker	● 0000	● 0000	● 0000	● 0000	● 0000
Meridian Personal Publisher	● 0000	● 0000	● 0000	● 0000	● 0000
OMI QuickTOPIX	● 00002	● 0000	● 0000	● 0000	● 0000

1- GEAR for Windows set-up rates a 5.

2- OMI is fixing the set-up procedure for the release version.

Key to Ratings: ●○○○○ → 00000
 POOR EXCELLENT

Table 3 Timing tests for a 633 megabyte sample data set. (see text for full explanation of test set-up.)

	CD-Gen	GEAR	Personal RomMaker	Personal Publisher	QuickTOPIX
Source Files to Physical Image File	64min 14sec	63min 14sec	26min 13sec	37min 55sec	No result!
Source Files to Virtual Image	No virtual ¹ publishing.	51 min 59sec	24sec	No virtual ¹ publishing.	No virtual ¹ publishing.
Source Files to CD-WO	103min 04sec (to Philips CDD 521)	92min 57sec (to Philips CDD 521)	101min 01sec (to JVC XR-W1001)	37min 51 sec ² (to Philips CDD 521)	No result. ³

1- These products do not support virtual publishing.

2- Calculated, not actual time. The version of Personal Publisher reviewed cannot output to 74-minute media on the Philips CDD 521 and therefore cannot write image files larger than 560 MB. The next release will remove this restriction. The time shown is extrapolated from results for a smaller data set (537 MB) output to a Philips CDD 521. The smaller set yielded a time of 32min 05sec. This result was extrapolated to the test data set size of 646,724,460 bytes (633 MB) assuming the same transfer rate.

3- QuickTOPIX for Windows could not pre-master our sample data, despite numerous attempts to do so. The program would abort when trying to pre-master a physical image file or pre-master direct to the Philips CDD 521 CD recorder.

For the timing results shown above in Table 3, the following typical pm-mastering scenarios were tested:

- **Source Files to Physical Image File** - The time it took to pre-master a physical image file starting from a DOS directory tree on a hard drive, and output to a CD-ROM physical image file on the same hard drive. The resulting physical image file was ready for output to a CD recorder or to tape for mastering at a CD-ROM replication facility.
- **Source Files to Virtual Image** - The time it took to pre-master a *virtual* image starting from a DOS directory tree on a hard drive, and output to a virtual image file. The virtual image contained pointers to the original data files on the source hard drive and not the actual byte-for-byte data. The resulting image file could be used for simulation purposes or, depending on the software, for output to a CD recorder or tape drive.
- **Source Files to CD-WO** - The time it took to create a CD-WO disk, starting from a DOS directory tree on a hard drive, and output to a CD recorder (type specified in the table). For the CD-Gen, GEAR and Personal RomMaker software, this was a two-step process. First, either a physical or virtual image file had to be created. Then the image file was written to the CD recorder. For Personal Publisher and QuickTOPIX, the first step is unnecessary and both programs pre-master and write to a CD recorder on the fly. The Philips CDD 521 is a 2X recorder and writes data at a rate of 300 KB/sec. The JVC XR-W1001 is a 1X device and can write data at only 150KB/sec.

The test set-up for the results shown in Table 3 was a USA Flex 33MHz 486 (ISA bus) PC clone with 8 MB of RAM (500K of available application memory). The source data consisted of 648,724,480 bytes (633 MB) of data in 657 files in a typical directory tree (85 directories, 3 levels deep, with no more than 24 files in any one directory). The source files were stored on a 680 MB partition of a 3.2 gigabyte SCSI hard drive array connected to a Western Digital 7000 SCSI controller in the host PC. The output device for the "Source Files to Physical Image File" and "Source Files to Virtual Image" was a second 680 MB partition on the same 3.2 gigabyte SCSI hard drive array. The output device for the "Source Files to CD-WO" was either a Philips CDD 521 or a JVC XR-W1001 CD recorder connected to an Adaptec AHA-1542B SCSI controller in a different slot in the host PC. Thus, the source hard drive and output device were on different SCSI device chains. The times indicated in Table 3 do not include the time to start up the programs or set-up the pre-mastering run.

Table 4: Comparison of features.

	CD-Gen	GEAR	Personal HomMaker	Personal Publisher	QuickTOPIX
Standards Support					
ISO 9660	✓ ¹	✓ ²	✓ ¹	✓	✓
CD-ROM XA	✓ ¹	✓ ²	✓ ¹		
Rock Ridge					
Mac HFS		✓ ²			✓
CD-1		✓ ²	✓ ¹		
CD-Audio	✓	✓ ²	✓ ²		✓ ¹
Mixed Mode	✓	✓ ²	✓ ²		✓ ¹
ISO 9660 Support					
Volume Descriptor fields can be modified	✓	✓	✓		✓
Volume Info can be saved for future use		✓	✓		✓
Default value for "Volume ID"?	none	name of volume	must be specified	none	"UNTITLED"
Default value for "Effective Date & Time"?	from system	from system	from system		zeroes
Default value for "Expiration Date"?	zeroes	Current date + 1,000 yrs	zeroes	zeroes	zeroes
Non-standard filenames allowed	✓	✓	✓		✓
Auto conversion of non-standard filenames		✓	✓	✓	✓
Premastering Features					
Pre-master to CD image file	✓		✓ ¹		✓ ⁵
Pre-master to tape		✓	✓		✓ ⁵
Master direct to CD-WO				✓	✓
Virtual Publishing		✓	✓		
Can specify exact target sector location	4	1	7	23	74
Batch commands	✓	✓			
Session log can be copied to batch file	✓	✓			✓ ⁴
Directory statistics maintained	✓	✓	✓		
Volume statistics maintained	✓	✓	✓		
Sector statistics maintained	✓	✓	✓		
Log files maintained	✓	✓	✓		✓
CD image file can be manually edited	✓	✓	✓		
Recreate disk structure from CD image file			✓		
Recreate disk structure from CD-ROM	✓		✓		
Simulation Features					
Simulation from CD image file	✓	✓ ⁶	✓		✓ ⁸
Simulation from virtual image		✓ ⁶	✓		
CD-ROM drive emulation	✓ ⁵	✓ ⁷	✓		✓ ⁸
Custom CD-ROM drive emulation	✓ ⁵		✓		✓ ⁸
File usage statistics maintained		✓	✓		✓ ⁸
Automatic optimization of disk layout					
Tape Support					
8mm E xabyte support	✓	✓ ¹⁰	✓ ⁹	✓	✓
4mm DAT support		✓ ¹⁰	✓ ¹⁰	✓	✓
9-track reel-to-reel support		✓			✓
Cartridge drive					✓
Read from labeled tape	✓		✓	✓	✓
Read from unlabeled tape	✓				✓
Write to labeled tape	✓	✓	✓	✓	✓
Write to unlabeled tape					✓
Master CD image direct to tape		✓ ²		✓	✓
Compare tape to disk	✓	✓	✓		
Tape dump or examine					

1 - Available late 1992 at extra cost.

2 - Available now at extra cost.

3 - DOS commands can be strung together in a DOS batch file.

4 - Uses "templates" to automate repetitive tasks.

5 - User must specify avg access time of CD-ROM player.

6 - Requires two computers.

7 - Choke of 4 CD-ROM drives.

8 - Separate set of Included programs.

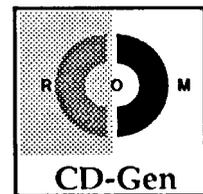
9 - Available in January 1993.

10 - Supports JVC DATA DAT only.

Table 4 (continued): Comparison of features.

	CD-Gen	GEAR	Personal RomMaker	Personal Publisher	QuickTOPIX
CD-WO Device Support					
Master direct to CD Recorder				✓	✓
JVC XR-W1001		✓	✓		
Philips CDD 521	✓			✓	✓
Sony CDW-900E	✓	✓			✓
Sony CDW-W1/E1		✓			✓
Yamaha 301/SCSI PDS		✓			✓

The following are brief summaries of the features and characteristics of each program. The programs are listed alphabetically by company name.



CD-ROM Strategies CD-Gen

Summary. CD-Gen Version 2.0 was reviewed for this article. The CD-Gen package includes the main CD-Gen program, which provides interactive and batch pre-mastering, and separate programs each for tape, CD recorder, and simulation support. CD-Gen can support the Philips CDD 521 and Sony CDW-900E CD recorders, CD-Gen software with Exabyte tape drive support only (no CD recorder support) is priced at \$495. CD-Gen with Exabyte and Philips CDD 521 support is priced at \$1,995. CD-Gen with the Philips CDD 521 recorder is \$7,995 and with the Sony CDW-900E recorder is \$11,995.

Set-up. The program requires MS-DOS 3.3 or higher and 512K bytes of memory. The install program automatically installs all necessary files on the user's hard disk.

Documentation. The tutorial section of the document is very good. It offers a quick way to jump right in with fairly detailed instruction on how to create and populate a VCD (virtual CD). This is not a true *virtual* CD in that a byte for byte copy of the data must be made prior to producing a CD-WO disk. The User's Guide section of the documentation provides a helpful summary of commands and menu options. The page numbers in both the index and table of contents in the documentation reviewed were incorrect.

User Interface. The user interface takes quite a bit of getting used to. The commands are selected by mouse or special keystrokes. In general the left mouse button selects a command, and the right button executes it. None of us found this method to be very intuitive. The help function is not context sensitive and can be frustrating. Command line versions of most commands are available, so that a batch file can be used to control processing. The tape, CD-WO and simulation features are separate from the main CD-Gen program.

Tape features. CD-Gen supports only the Exabyte 8200 8mm tape drive. The two external tape programs available are "DSK2EXA," which writes an image file to Exabyte tape and "EXA2DSK," which sequentially reads files off of tape, requesting a file name for each file encountered.

Pre-mastering features. The user creates a pre-mastering partition called a virtual volume, or VCD, then populates it by selecting directories or files from DOS disks and transferring them to the virtual volume. Some of the messages will be confusing to a novice user. For example, when copying a file to the VCD, the user is asked if the sector location shown is the sector where the file should be copied. One very nice

feature is to defer copying files until after the VCD is assembled. This is not the default and this option must be selected prior to copying files into the VCD. Before "updating" the VCD (the byte for byte copying of data to the VCD) the user can compress the VCD to get rid of any "holes" caused by files that were deleted from the middle of the volume. When satisfied with the VCD layout, the user can then "update" the virtual volume. Keystrokes can be recorded and re-played later. Once the size of a VCD is specified, it can not be changed. This would not be so bad, except that the size of the entire virtual volume is written to disk instead of just the part that contains data. Thus, if the user has defined the VCD to be 660 MB and it contains only 380MB of data, all 660MB will be written to CD-WO or tape,

Simulation. Simulation of a VCD can be performed using a separate simulator program. The CONFIG.SYS file must be modified and MSCDEX run to invoke simulation. An average access time can be specified to simulate a certain drive speed. No statistics on file usage are maintained,

CD-WO features. CD-Gen supports the Philips CDD 521 and Sony CDW-900E CD recorders. A separate CHECKRD program is provided to test the speed of the user hard disk to verify that it can support 2X speed writing to the Philips recorder. Another program, MASTERCD, actually writes the disk. No status is provided during the transfer. The Philips CDD interface software is menu driven and easy to use.

Warranty/Technical Support. Bug fixes for software are free. Technical support (applicable toll charge to 714 area code) M-F 8am-5pm PST.

Utilities. There is a search option that allows searching either the DOS partition or the VCD partition for file or directory names. A dump/edit capability is also included,

Misc. CD-Gen version 2.1 upgrade will include multi-session CD-WO writing. CD-Gen is a product of CD-ROM Strategies, Inc. and Tata Unisys, Ltd.



Elektroson GEAR

Summary. The product reviewed was GEAR 150 DOS 150 Version 1.1. GEAR consists of four separate modules, CDGEN - to generate a CD volume, CDTAPE - for tape utilities, CDR - to write the volume to a CD recorder, and CDTRACE - for emulation/simulation. CDGEN and CDTAPE are bundled for \$2,500, CDGEN and CDR are \$3,000; all three modules are \$3,500. The CDTRACE software can be purchased with any of these packages for about \$2,700 extra. Each module provides a command line interface but the commands can also be executed in batch mode. A batch version of the program can be purchased for about \$1,000 less per module for those on a tight budget.

Set-up. The program requires DOS version 3.3 or higher and 500K bytes of memory. Installation must be performed manually. Program files are copied from floppy to a directory on hard disk. A path variable (GEARDIR) must be set in AUTOEXEC.BAT. The GEAR.INI file containing the volume descriptor fields should be edited to set local default values which will be used when volumes are created. Note: the default settings reference non-existent bibliography and copyright files.

Documentation. The documentation is simple and clear, although sparse on information in sections. The opening tutorial walks the user through all of the basic features needed to create, populate, simulate and write an image to tape or CD-WO. The example could be more robust to give the user a better understanding of program features.

User Interface. The command line interface is simple and most of the commands will be intuitive to DOS users. All user interaction can be captured in a log file, which can then be edited and replayed as a script. Help is supplied via a HELP command, but the command descriptions are sparse.

Tape features. The GEAR tape module supports various SCSI 8mm Exabyte, 4mm DAT and 9-track tape drives. Tape functions include the ability to write a virtual volume or image to ANSI labeled tape. Other files containing mastering set-up information can also optionally be written to the tape. A verify option compares a volume on hard disk with one on tape. GEAR also will allow writing an image file that has been pre-mastered on another system to tape. There are no programs for reading files from tape.

Pre-mastering features. The software is logical and easy to use. The on-line help is good enough and the commands self-explanatory enough to get by without the documentation. True virtual volumes can be created with the GEAR software. The virtual image can be written to CD-WO without creating a physical image file first. The size of the volume can be changed after pre-mastering has begun. The DELETE functions require specification of the semi-colon, which GEAR appends to the file name. This is quite a nuisance.

Simulation. GEAR provides a unique simulation capability that turns the PC into a CD-ROM reader. However, this unique set-up requires two computers. This involves installing a second SCSI interface card and running the CDTRACE program. From this point on, the SCSI port of the first computer looks to another machine like a CD-ROM reader. This allows testing of applications on other platforms (Mac, Sun) if generic SCSI drivers are available on these platforms. Several different CD-ROM readers can be simulated (Sony, NEC, Toshiba, Apple). We had problems with the simulation features during testing. The SCSI board address settings in the GEAR initialization file did not match the default settings which the board was shipped with (GEAR.INI was set for address 300, while the board was set for address 330). This will doubtless confuse many users. Using a Macintosh as the host computer we attempted to simulate a Sony, NEC and Toshiba CD-ROM using the latest Apple, NEC and Toshiba drivers. While the SCSI device was recognized by the Macintosh, we could not get the ISO image to mount on the desktop. Using the NEC drivers the simulator appeared as an audio CD with two tracks.

The CDTRACE program generates statistics for all file accesses and can also display SCSI commands that are sent by the host machine. The high price of this feature (\$2,700) could only be justified if a great deal of testing must be done and if multi-platform testing is required.

CD-WO features. The GEAR CD-R module reportedly supports all known CD recorders on the market, including the JVC XR-W1001 (although JVC typically does not unbundle its CD recorder from its software packages). The software was tested only with the Philips CDD 521 and worked correctly. The CD-R module allows writing a volume to CD-WO, writing an external CD-ROM image file pre-mastered on any software package to CD-WO, and has a special ESTIMATE command that measures the throughput rate of the computer system to determine if it is fast enough to support direct writing to the CD recorder.

Warranty/Technical Support. 90 day warranty includes free support (updates and further support when required) and maintenance. After this period, a software and maintenance contract costs 10% of sales price annually.

Misc. Versions of GEAR for Windows, UNIX systems (System V/386, HP 9000/700) and the Macintosh are also available. A multi-media version of GEAR (for DOS or Windows) will support creation of CD-Bridge, CD-I, CD-ROM XA, and Electronic Book disks. Elektroson also offers a simple DOS product for mastering a DOS directory tree on a hard disk to a CD Recorder. Called *My First GEAR*, it costs \$999.

We received a pre-release copy of *GEAR for Windows* just before our publication deadline. The program is essentially a direct port from the DOS version, but with some extremely useful capabilities missing (volume listings, log function, batch mode). It does provide the capability to include digital audio or CD-ROM XA tracks in an image. While the point and click access to commands makes it slightly easier to use than the DOS version, especially in selecting files to be copied to or deleted from the virtual image,

the added case of use is probably not worth the higher price (planned price is about \$1,000 more than the DOS version). It is clear that this version was rushed out the door too quickly (for example, the help screens are only partially implemented) and needs work. Elektroson promises that the Help function will be implemented, and more features added, by the version 1.1 update planned for release at the beginning of 1993.



JVC Personal RomMaker

Summary. The JVC personal RomMaker comes in three configurations. *The Digital Audio Tape (DAT)* only system (\$6,000) includes a stand-alone external JVC DATA-DAT tape drive, and allows production of a pre-mastered image and simulation using the DAT drive as if it were a hard disk. The WCD-ROM system (\$12,799) includes a 680 megabyte hard disk and a JVC CD recorder (XR-W1001). The third configuration sold is the WCD-ROM/DAT system (price \$15,799) and combines a 680 megabyte hard disk, a JVC CD recorder, and a JVC DATA-DAT tape. The WCD-ROM and WCD-ROM/DAT systems are housed in a mini-tower case. All three configurations include the Personal RomMaker software. The low end Digital Audio Tape (DAT) system will suffice if pre-mastering is the only requirement. The WCD-ROM recorder option is appropriate if disks must be written locally for testing or data distribution functions.

Set-up. System requirements include a 386 or higher IBM compatible computer running DOS version 3.31 or higher. At least 500K of usable DOS memory must be available to run the RomMaker software. One megabyte of extended memory using HIMEM.SYS or other extended memory manager is needed to store the virtual CD-ROM. The programs and utility files require 2 megabytes of hard disk space. Additional local or network disk storage is required for the files that will be pre-mastered (up to 680 megabytes for a full CD-ROM). In addition, the regular installation program checks the devices and allows the user to specify an editor program.

Documentation. The included documentation is thorough and easy to understand. The manual presents a step by step walk-through of the process of creating a CD-ROM disk, using book publishing as a metaphor. The manual also includes an extensive troubleshooting section with useful tips for solving problems.

User Interface. The program presents a windows-like menu screen which provides access to program functions that are actually separate programs. The program's ISO 9660 compliance is solid and easily allows editing, saving, and re-using information for all of the ISO 9660 volume descriptor fields.

Tape features. The program supports writing to and reading from the JVC DATA-DAT tape drive. The program does not support any other tape device. However, JVC plans to support 8mm Exabyte in its next scheduled software release. The program also allows verification of a CD-ROM image file by comparing the image on tape to the hard disk image. The ability to access the JVC DATA-DAT tape drive as a random access device and simulate a CD-ROM image is simply revolutionary (assuming one has the patience to wait for the tape drive to access the tape).

Pre-mastering features. The program has full ISO 9660 support including filename conversion options. A CD-ROM image file is pre-mastered by entering a volume identification and creating a layout file, which provides a script for the pre-mastering process. In the script file, the user specifies the source files to be included on the CD-ROM and the location where they will be placed. The simplest way to set up a volume is to build the entire CD-ROM file structure on a hard disk, then specify 'G:*.* \ -d' in the

layout file where 'G:*.*' indicates all the files on hard disk drive G, '\' indicates the destination virtual CD-ROM and the '-d' flag specifies that all files and sub-directories are to be copied. Other switches allow hidden files to be copied and dates to be kept or adjusted when copying. Because the script file must be created using a text editor, the pre-mastering process can be laborious. One flaw in the pre-mastering process is that if the script file contains a CTRL-Z, which many DOS editors use to mark the end of a file, the pre-mastering process terminates.

Simulation. The program allows simulation from a virtual image or the actual image if it is stored on the included DAT or hard drive. New drive emulations can be created, though the user is not informed of the characteristics of the drives. Statistics are generated for file opens and seek time. Optimization of the CD layout is well thought out, but poorly implemented. A host of usage statistics can be generated using the simulation features, but optimization requires an undue number of steps and begs to be simplified.

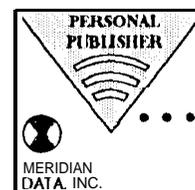
CD-WO features. Personal RomMaker supports only the JVC CD Recorder. The JVC Write Once CD-ROM recorder is a dual-purpose device, functioning both as a CD-ROM writer as well as a player.

Warranty/Technical Support. One year warranty on software and hardware including toll-free technical support. Hardware can be returned to JVC for repair during the warranty period and a 5-day turnaround time is promised.

Utilities. The program comes with a dump/edit program which can be useful in making last minute corrections to the contents of an image file. A compare utility allows image files to be compared between disk, tape and CD-ROM disk. We used this utility to verify a vendor error on one of our CD-ROM titles.

Misc. Both CD-ROM XA and CD-I will be supported in late 1992 at extra cost. A Macintosh version of the Personal RomMaker is available and can produce hybrid disks supporting full ISO and Macintosh access with System 6 and 7 compatibility. A Mixed Mode PC version of RomMaker, called "Mixed Mode RomMaker" is also available now for \$15,700. It includes the JVC CD recorder and a 680 megabyte hard drive in the mini-tower case, and a special Mixed Mode version of the RomMaker software that enables recording of data (Yellow Book), CD-Audio (Red Book) or Mixed Mode (Red Book/Yellow Book) CD-ROMS. A Mac version of Mixed Mode RomMaker will be available in January 1993,

JVC also recently introduced a separate pre-mastering package called the Personal Archiver. The Personal Archiver (\$9,950) includes the JVC CD recorder (XR-W1001) and 680 megabyte hard disk in the mini-tower case, a SCSI interface card, SCSI cable, and formatting software. While similar to the WCD-ROM configuration of the Personal RomMaker, the lower-priced Personal Archiver does not include the Personal RomMaker software, and comes instead with its own formatting software. The product is designed for users and system integrators wishing to archive large amounts of data directly to a CD-ROM or CD-WO. The new Personal Archiver software reportedly offers a small sub-set of the capabilities in RomMaker, but adds ease-of-use features like "on-the-fly formatting" and batch processing. A Mac version of the Personal Archiver is planned for release in January 1993,



Meridian Personal Publisher

Summary. Personal Publisher version 1.0a6 with Philips CDD 521 CD recorder was reviewed for this article. The software alone with tape output capabilities only is priced at \$495. The software with tape and CD-WO output is \$1,995. The software bundled with the Philips CDD 521 recorder and an Adaptec SCSI board is \$7,995. A network license for the software for one local area network is \$4,995. The Meridian

Personal Publisher software provides the capability to generate a CD-ROM image file or write-once disk from a single DOS directory tree.

Set-up. The program requires a DOS computer with 386/20MHz processor or better, 4 megabytes of available extended memory, and a hard drive with a minimum sustained transfer rate of 600KB per second and large enough to hold all the files that will be on the final CD image. The hard drive must be on a separate SCSI bus than the Philips writer. The installation program automatically installs all necessary files on the user's hard disk.

Documentation. The documentation is concise and logically organized. It provides thorough installation instructions, introduces the user to CD-ROM publishing, and lists instructions for making a CD-ROM image and outputting to CD-WO, tape, or to hard disk. The appendices provide useful information about CD-ROM performance factors and the physical and logical format of CD-ROMs.

User Interface. Personal Publisher is extremely easy to use, with a very simple, logical interface. Meridian has obviously intended the program for end-users. Ease-of-use is emphasized at the expense of advanced options offered in the company's other pre-mastering software products. The user selects the source, destination, volume id and that's it. The commands can also be executed in batch mode (e.g. "PPUB /n:TESTDATA C:\DATA to CDW", will record all files and subdirectories in C:\DATA using "TESTDATA" as the volume id).

Tape features. Personal Publisher supports most external SCSI 8mm Exabyte or 4mm DAT tape drives. An external LOADANSI program is provided for transferring files to and from tape. The tape utility is a separate program but will be integrated into the main program for the final release version.

Pre-mastering features. To create a CD-ROM image, the user simply specifies the source directory (only one directory tree allowed), the output device (tape, CD-WO, or a disk image file), and enters the Volume ID and specifies whether to overwrite a file if two files with the same name are encountered. None of the ISO 9660 Volume Descriptor fields except the VOLUME_ID can be specified.

Simulation. No simulation features are provided.

CD-WO features. Only the Philips CDD 521 is supported. The Philips drive records at 2X speed only. Personal Publisher can pre-master directly to the Philips drive if the source hard drive is fast enough. This direct-to-CD publishing capability is extremely fast and cuts traditional publishing times in half.

Warranty/Technical Support. 1-year on software and hardware, includes toll-free technical support, access to Meridian's on-line bulletin boards, and discounts on software upgrades.

Misc. A special driver is included that lets the Philips CDD 521 be used as a CD-ROM playback unit. Meridian reports that other CD recorders will be supported in a future release. By the time of this printing, Meridian plans to replace Personal Publisher with *Personal SCRIBE*. Personal SCRIBE is reported to be similar in intent, user interface, and execution to Personal Publisher with some added features. Personal SCRIBE will allow creation of multi-session CDs, will support reading and writing to unlabeled tape, will allow full editing of ISO 9660 volume descriptor fields, and will include two new utilities that ease the "on-the-fly" pre-mastering to CD-WO capability already present in Personal Publisher. The new utilities include a "Prediction Module" that calculates throughput performance of the user's host PC before writing to CD-WO to ensure data transfer rate to the CD recorder can be maintained. The second utility, called the "Performance Module" will reportedly offer null padding and file re-ordering to help sustain the data transfer rate to the CD recorder. Pricing for Personal SCRIBE will be the same as Personal Publisher for tape output support (\$495), and \$1,000 more for the tape/CD-WO software-only version (\$2,995) and Philips CDD 521 bundle (\$8,995). Meridian also sells a more feature-packed CD publishing software package called *CD Publisher*. CD Publisher is intended for CD-ROM developers and is

considered the standard by which other CD publishing programs are measured. While less capable, Personal Publisher is significantly easier to use.

Optical Media International QuickTOPIX for Windows



Summary. QuickTOPIX for Windows version 1.1 was reviewed for this article. The tape-only version of QuickTOPIX is priced at \$695. The CD-WO version is \$2,500. Other options include either the Philips CDD 521 (\$6,000) or Sony CDW-900E (\$10,000) CD recorders, and CD-Audio/Mixed Mode support for software (\$1,500 extra). If the user already has a CD recorder, software keys that support various CD recorders can be purchased at additional cost. OMI can also custom configure any system the user wants, including any combination of supported tape drives, CD-Writers, and hard drives.

Set-up. QuickTOPIX requires a 386 or 486 PC compatible (486 required for writing to Philips and Sony CD Writers in real time at 2X mode), 4MB RAM, an Adaptec 1542,1640 or 1740 SCSI host adapter, parallel port, VGA display, MS-DOS 3.1 or 5.0, MS Windows 3.1, a hard drive with minimum formatted capacity of 650 MB, a CD recorder and/or tape drive, and CD-ROM drive (recommended). The current set-up procedure is very complex, but is being automated by OMI and will be considerably easier in future versions. QuickTOPIX is copy-protected through the use of a software lock that attaches to the parallel port of the host computer. The software lock originally shipped in our review package was defective and although we received a replacement lock two days later, OMI normally requires return of the original defective lock before they will send out a replacement.

Documentation. The documentation describes the set-up process, then provides a brief overview followed by examples of many different pre-mastering scenarios. A reference section shows how to use the special menus for tasks like editing volume descriptor fields, translating invalid file names, etc. The appendices provide a good introduction to CD-ROM technology and the most thorough explanation of various CD standards among the reviewed packages. The reference in the examples of an 'Unencoded Disk Image File' as an input or output of many operations is somewhat confusing terminology.

User Interface. QuickTOPIX runs under Windows 3.1 and has a Motif-like interface. Program features are accessed through on-screen forms called "QuickForms", which contain fields to be filled in, and buttons that link to other windows or fields. Although not intuitive at first, the interface facilitates ease of use after a limited amount of experience. The QuickForms are used to specify publishing information such as Source and Target devices and formats, logical data formats for the CD, CD volume information, processing options (such as ISO 9660 filename conversion), and project management information. The forms can be saved for use at a later time. The most confusing aspect of the program in general is its terminology for the different CD-ROM pre-mastering capabilities. Also, the selection 'RAW' in the menu screens seems to have a variety of meanings from task to task. The main menu screen has a rotating magenta OMI Insignia that some users might find annoying.

Tape features. QuickTOPIX supports a full range of SCSI tape devices: 4mm DDS DAT, 8mm Exabyte, 9-track, and cartridge drives. QuickTOPIX supports writing to and reading from unlabeled, ANSI labeled and IBM labeled (ANSI format with EBCDIC characters) tapes.

Pre-mastering features. Pre-mastering is quite simple using the QuickTOPIX interface. The user selects a source directory (only one directory tree allowed), a Target device, and any special processing options. If pre-mastering to tape or to a CD recorder, QuickTOPIX first performs a simulated transfer of data from the source directory to the CD recorder to see if the data transfer rate is fast enough. To write to the

Philips CDD 521 or Sony CDW-900E in 2X mode, the minimum data transfer rate required is 600KB/see. This test operation is done for the complete source directory. QuickTOPiX allows for "turning off" certain ISO 9660 restrictions when pre-mastering a CD. File version numbers can be stripped from the ends of filenames, invalid filenames can be allowed, and directory depths greater than 8 levels can be allowed. QuickTOPiX has two special features that facilitate repetitive pre-mastering tasks. The first is called "AutoPrint templates" and essentially allows the user to save and re-use a template file that contains a full set of pre-mastering instructions. The second innovative time saver is the drag-and-drop QuickPrinter feature. This feature allows the user to set up a special icon on the Windows desktop that performs a repetitive CD publishing task. For example, a QuickPrinter can be set up that will write data to a CD recorder or tape drive. Then, to create the CD or tape, the user simply selects a directory or CD-ROM image file using Windows' File Manager, and drag its icon on to the QuickPrinter icon. Log files are called "Reports" in QuickTOPiX. Reports can be turned on or off, and examined after program operation has completed.

Simulation. Simulation and optimization capabilities are included with QuickTOPiX as a group of separate programs originally packaged with OMI's pcTOPiX. However, we could not get the simulation programs to function correctly with image files output from QuickTOPiX.

CD-WO features. QuickTOPiX can support the Philips CDD 521, Sony CDW-900E, Sony CDW-W1/E1, and Yamaha 301 /SCSI PDS CD recorders. The software supports both CD-ROM Mode 1 and CD-ROM Mode 2, Form 1 track types. It automatically adapts to the recording speed of the CD-Writer used. For example, the Sony CDW-W1/E1 writes only at 1X (or single) speed. The Philips CDD 521 writes only at 2X (or double speed). The Sony CDW-900E can write at 1X or 2X speeds and is user selectable in QuickTOPiX. A setting in the 'Preferences' window allows QuickTOPiX to perform a media defect and data throughput analysis before actually writing data to tape or CD-WO. The biggest weakness of QuickTOPiX is the performance penalty for running under Windows. We had numerous problems installing and running version 1.1 of QuickTOPiX on our test equipment (a 33 MHz 486 PC compatible with 8MB of RAM). We found the software to be unstable on our test set-up. We were also never able to output to our Philips CDD 521 CD recorder despite telephone assistance from OMI technical support and repeated efforts by us to fix the problems,

Misc. The program can pre-master a CD of DOS, Macintosh or UNIX file structure from a device image (i.e. a hard drive that is formatted in its native file structure and connected to the Adaptec SCSI board for access by the QuickTOPiX software). However, QuickTOPiX cannot create or edit the contents of these device images. QuickTOPiX for the Macintosh will be released in early November 1992 and QuickTOPiX for Silicon Graphics and UNIX will be available some time later. OMI, founded in 1985 and a pioneer in the CD-ROM publishing field, also sells more advanced CD publishing programs that first appeared on the market in 1986. MacTOPiX and pcTOPiX are the predecessors to QuickTOPiX and have publishing features and standards support not available in QuickTOPiX.

Conclusions

Each of the systems reviewed in this article has certain special capabilities and drawbacks. It is very important for the user to clearly define the environment in which pre-mastering and CD recording will be conducted to determine which program features are important. For example, tape utilities might be totally useless if all data is accessible via network. Other important considerations are identified below.

1. Some double-speed (2X) CD recorders require that they be the only device on that SCSI board. If you will be frequently using other SCSI devices (Exabyte or DAT tape), having only one SCSI board will require swapping devices between operations, a tedious and error-prone procedure.

2. If you will be using a network, determine how much memory your network software takes and be sure that the program will operate in that amount of memory.
3. If you are getting a CD recorder, simulation capabilities become much less important. The best possible simulation is to write a disk and give it to a real user. Your own internal testing probably will not match that of your users on their own machines,
4. If you must make Macintosh compatible disks you can use the JVC Personal RomMaker for Macintosh (can produce ISO, HFS or hybrid disk with complete Mac and ISO compatibility); the OMIMacTOPiX (essentially copies a hard-disk to CD-ROM) to make an HFS or ISO disk; the Meridian Mac CD-Publisher software (makes semi-compatible Mac disks with System 6 support only); the Elektroson GEAR for HFS/Mac (support creation of both HFS and ISO disks); or OMIQuickTOPiX for PC can make Macintosh HFS format disk from a hard disk or partition image.
5. If you need to produce UNIX compatible CD-ROMs with long file names containing special characters you can use the Young Minds Makedisc software (which can produce a UNIX disk image or ISO compatible Rock Ridge disk); one of Elektroson's UNIX products (GEAR HP UNIX or interactive UNIX 386/486 for PCs); or OMIQuickTOPiX or JVC Personal RomMaker, which both can make a UNIX disk image.
6. If you need to produce VAX compatible CD-ROMs (with extended attribute records providing record format information) you must use either the Meridian Data Inc. CD-Publisher on the PC or the TMS VAX Disc Architect pre-mastering software (which is no longer supported by TMS, but is still the workhorse for JPL CD-ROM production). None of the pre-mastering packages reviewed for this article will create XARS.

Issues in producing multi-platform CD-ROMs

Most CD-ROM titles produced to date have ignored the issue of multi-platform access to software and data. This is partly because such access has been difficult to provide without a great investment in time and effort by the producer. In developing the Mars Digital Image Mosaic CD-ROM collection, we decided to fully support PC, Macintosh, VAX and UNIX platforms. The production process involved:

1. receiving the CD-ROM data sets in VAX backup format on 8-mm tape;
2. restoring the files to a local VAX computer;
3. running a utility program that read the VAX directory for the volume and generated a CD-Publisher command file (including XAR specifications);
4. running the command file on the PC utilizing PC-NFS (PC - Network File System) to access the files on the VAX and build an ISO partition on the CD-Publisher system;
5. connecting the Publisher to a Macintosh and adding the Mac software directory to the ISO partition;
6. finally, generating an image from the ISO partition.

Was the result worth the trouble? We can only say that there have been no complaints from any of the 500 recipients of the CD-ROM set and it is actively being used on all target platforms. Other issues in multi-platform CD-ROM production are described below.

Text files. Unfortunately, each of the major computer platforms has developed its own interpretation of what constitutes a simple text file. In the following examples <CR> stands for carriage return (hex OD), <LF> stands for line feed (hex OA) and <LENGTH> stands for a 2-byte length field stored in Least Significant Byte (LSB) first notation.

IBM PC	This is a line of text.cCRxLFz
Macintosh	This is a line of text.<CR>
UNIX workstation	This is a line of text.<LF>
VAX/VMS workstation	<LENGTH>This is a line of text.*

* This is the most common format supported under VMS.

Only the IBM PC format will display properly on the other platforms. For this reason the Data Distribution Laboratory uses the IBM PC version for all simple text files. There are vendor supplied utilities that can translate the IBM PC format to internal format. These are Apple File Exchange on the Macintosh, dos2unix or the translate (tr) utility on UNIX workstations and Convert on VAX/VMS workstations. The other option is to include four versions of each file, which can become a configuration management nightmare,

File naming. It is unfortunate that the limitations of MS-DOS have put stringent restrictions on file names that can be used on transportable CD-ROM volumes. The ISO 9660 standard provides levels of interchange to insure that all file systems will be able to access CD-ROM files. Level 1 requires that names be composed of one to eight (upper case) characters with a three character extension. File names may only contain alphabetic and numeric characters and the underscore character. Other platforms are more lenient in the number of characters allowed (MAC -31, VAX -64, UNIX - 128) and which characters may be included. For example, Macintosh file names may include spaces. UNIX file names may contain a variety of special characters and multiple 'periods', which is disastrous on IBM PC or VAX systems.

File version numbers. The dreaded semi-colon issue. Imagine building a Macintosh retrieval application that accesses files on the CD-ROM by filename, You test it thoroughly, then cut an ISO 9660 disk, Imagine your chagrin when you find your application does not work at all from the CD-ROM, because the pre-mastering software appended a ';1' version number to all file names. Different drivers for different operating systems handle the version number differently. The IBM PC ignores it. The Macintosh CD-ROM driver developers felt obligated to maintain the version number with the file name. Thousands of hours of effort have been expended (and wasted) due to this idiosyncrasy. Even worse, one cannot always assume that the version number will be 1. A CD-ROM pre-mastered on a VAX computer takes the version number from the original data file, so it will very often be a higher version number.

Macintosh Files. The Macintosh file system partitions files into resource forks and data forks. Resource information includes the file type and file creator, encoded as 4-byte identifying strings. Files are represented by the operating system as pictorial ICONS, which are also stored in the resource fork. If these files are pre-mastered on a standard ISO 9660 CD-ROM they will appear to the Macintosh as text files. Clicking on an application will not work, Thus Macintosh executable and special file types are most commonly stored in some compressed (typically Stuffit) or BINHEX format. They must then be uncompressed or un-BINHEX'ed to the user's hard disk before use. This approach has the advantage of avoiding the version number problem mentioned previously. It has the disadvantage of enormous user complexity. Try describing the process to a naive Mac user who does not have Un-Stuffit or Binhex on his/her computer.

Extended Attribute Records. Extended attribute records provide a method of retaining basic file characteristics (record type, record length, record attributes), file protection settings and time tags for files recorded on ISO CD-ROMs. These records are most important in the VAX/VMS environment, where record structure information is often required by software. The new VAX/VMS CD-ROM (System 5.5 and above) support allows default attributes to be set when a volume is mounted.

CD-ROM flavors

ISO 9660

ISO 9660 is the international standard for transportable CD-ROMs. Thanks to the support of Jerry McFaul's Special Interest Group for CD-ROM Applications and Technology (SIGCAT) every archival CD-ROM produced by government agencies has used the ISO standard. Figure 3 shows how the ISO 9660 file structure is organized using a sample CD-ROM, and how DOS interprets the file structure.

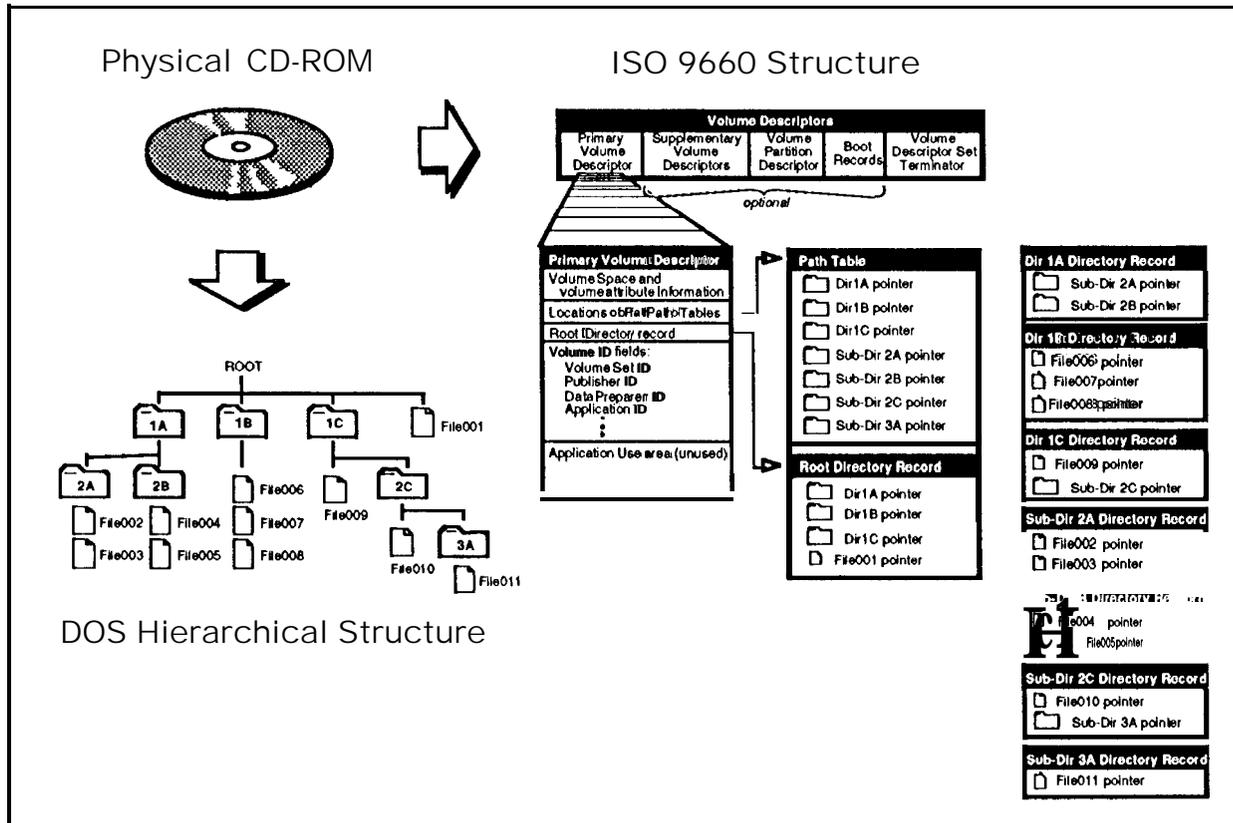


Figure 3: Example CD-ROM and how it is implemented in ISO 9660.

High Sierra

While this landmark 'standard' was useful for a period of about 9 months while ISO 9660 was being approved, High Sierra is NOT a standard and no one should use it! But, alas, Microsoft's new Bookshelf for Windows is still recorded in High Sierra format. Many PC directed titles use this format.

Macintosh Hierarchical File System (HFS)

Macintosh Hierarchical File System format is useful for making Macintosh-only CD-ROMs. Apple uses this format for its products, primarily for performance reasons. Methods of making Mac compatible ISO 9660 compliant CDs on other platforms are now available if transportability is an issue.

Macintosh ISO 9660 disk.

Apple has implemented a file system based on ISO 9660. Since the data and its information for a single file in HFS or MFS is stored in two different places called the Resource Fork and the Data Fork, extra features are required for mounting HFS/MFS files from ISO 9660 volumes. Thus,

Macintosh implemented the System Use field in the directory record and the associated file, which is supported by the directory record file flags. Information that belongs in the Resource Fork is recorded in the associated file, while data resides in a normal file (see Figure 4). This implementation for the associated file is especially important for storing executable files, since all of an executable file and its information resides in the Resource Fork. However, in most cases, none of the non-Apple vendors implement these features for either pre-mastering software or CD-ROM drivers. Thus, in order to record Apple Macintosh files, one must pm-master on Macintosh systems.

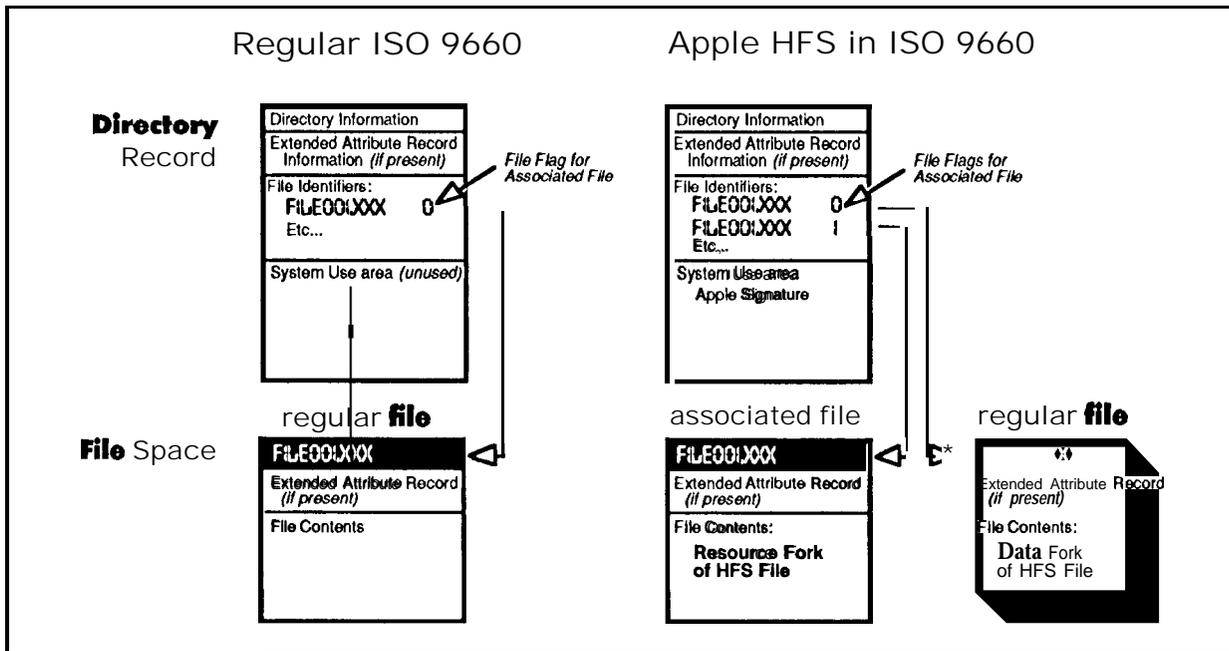


Figure 4: Implementation of Apple Macintosh HFS in ISO 9660.

Rock Ridge.

The purpose of the Rock Ridge initiative was to create and agree upon a common format by utilizing the system and application area in the directory record of the ISO 9660:1988 format while maintaining compatibility with the installed base of ISO 9660:1988 hardware and software in the UNIX environment (see Figure 5). This proposed standard uses the System Use Area and Application Use Area in the directory record to include necessary information such as UID, GID, mode bits, major and minor device, UID, and GID numbers by receiving systems for X/Open systems. Thus, this scheme will eliminate the XAR fields and increase CD-ROM drive performance. It also sets up a standard procedure for sharing System Use Areas.

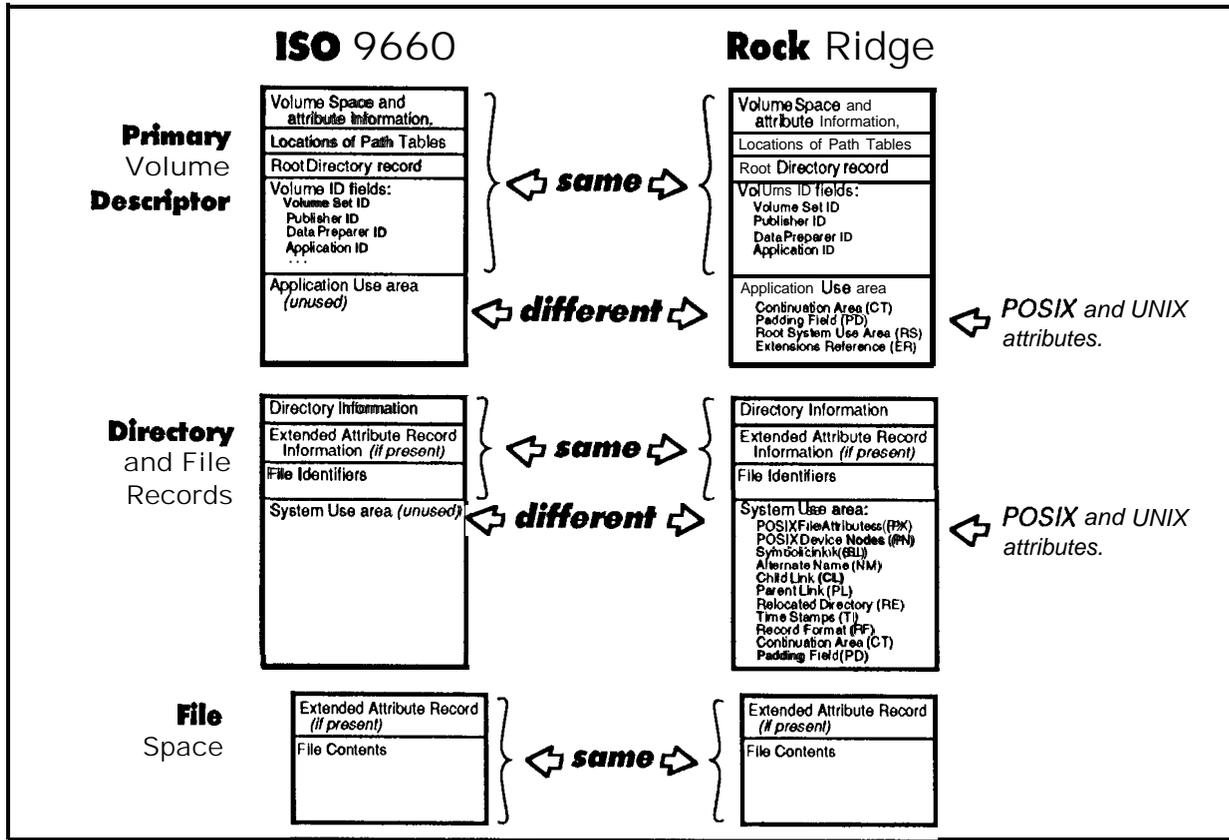


Figure 5: Differences between ISO 9660 standard and Rock Ridge Trepoal.

CD-WO Standard

CD-WO is an evolution of CD-ROM to a sequential write-once medium and is defined by the Orange Book. A group called the ECMA (European Computer Manufacturer Association) TC15 working group, informally known as the Frankfurt group, is working on the volume and file structure standard for CD-WO. This standard group has produced ECMA 167, which defines volume and file structure for WORM and Erasable media, and ECMA 168, which is upward compatible with the ECMA 119 and the ISO 9660 standards. These two ECMA standards are expected to be accepted as ISO standards.

UNIFILE

UNIFILE is Digital Equipment Corporation's (DEC) CD-ROM format, used on most of DEC's VAX/VMS CD-ROM products. With Version 5.5 of VAX/VMS, DEC now provides built-in supports for ISO 9660 and High Sierra CD-ROMs, and hopefully UNIFILE will disappear,

Products mentioned in this article

CD-Gen

CD-ROM Strategies
18 Chenile
Irvine, CA 92714
Phone: 714-733-3378, Fax: 714-786-1401

CDPrepare, CDMake

Dataware Technologies, Inc.
222 Third St., Ste. 3300
Cambridge, MA
Phone: 1-800-229-2222, Fax: 617-621-0307

GEAR, My First GEAR

Elektrosen BV
Veldersweg 25
5298 LE LIEMPDE
The Netherlands
Phone: 31-4113-3021 Fax: 31-4113-2763
(North American Distributor for GEAR):
CD-ROM, Inc.
1667 Cole Blvd., Ste. 400
Golden, CO 80401
Phone: 303-231-9373, Fax: 303-231-9581

The Personal RomMaker,

The Personal Archiver

JVC Information Products
19900 Beach Blvd Suite I
Huntington Beach, CA 92648
Phone: 714-965-2610, Fax: 714-965-9071

Personal Publisher, Personal SCRIBE, CD-Publisher

Meridian Data, Inc.
Scotts Valley, CA 95066
Phone: 1-800-767-2537, Fax: 408-438-6816

QuickTOPiX for Windows, pcTOPiX, MacTOPiX

Optical Media International (OMI)
180 Knowles Dr.
Los Gates, CA 95030
Phone: 408-376-3511, Fax: 408-376-3519

Disk Architect

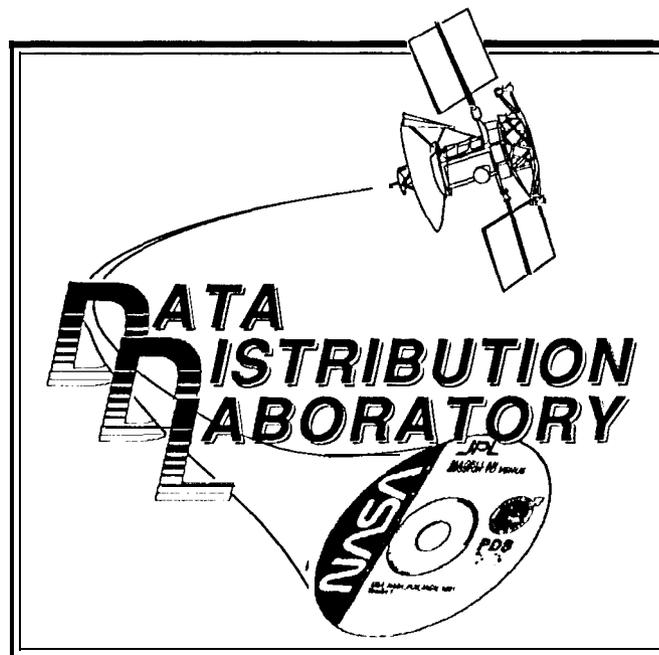
TMS, Inc.
110 W. Third St., PO Box 1358
Still water, OK 74076
Phone: 405-377-0880

Makedisc

Young Minds, Inc.
1910 Orange Tree Ln., Ste. 300
Redlands, CA 92374
Phone: 714-335-1350, Fax: 714-798-0488

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NASA's Data Distribution Laboratory

The Data Distribution Laboratory is operated by the Jet Propulsion Laboratory for NASA'S Information Systems Office. The goal of the lab is to make it easier for scientists and engineers to put their data on CD-ROM or CD-WO disks. The first year objective was to set up a pre-mastering and CD-recording capability and produce 30 write-once disks. The lab actually produced over 150 disks in its first year of operation, and 450 disks in the second. It has supported NASA's science disciplines (Astrophysics, Climate, Earth Science, Planetary and Space Physics) by making write-once test disks or pre-mastering CD-ROMs. It has also produced test versions of nearly all of JPL's flight project CD-ROMs, supporting Magellan, Galileo, Voyager, Mars Observer and TOPEX.

Besides providing support for CD-ROM production, the lab:

- * tests new CD recorders, readers and jukeboxes
- * evaluates other mass storage devices, such as WORM and MO jukeboxes
- * collects and documents scientific CD-ROMs from other agencies
- * collects and develops utility software for use with scientific data sets (display programs, volume production tools)
- * evaluates compression techniques for use with scientific collections
- * develops techniques to automate data collection, documentation and volume production
- * develops multimedia programs for scientific data access and display

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